"The Earth's well-being is . . . an issue important to America—and it's an issue that should be important to every nation and in every part of the world. My Administration is committed to a leadership role on the issue of climate change. We recognize our responsibility, and we will meet it—at home, in our hemisphere, and in the world."—George W. Bush, June 2001

Chapter 1
Introduction and Overview

With this pledge, President Bush reiterated the seriousness of climate change and ordered a Cabinet-level review of U.S. climate change policy. He requested working groups to develop innovative approaches that would: (1) be consistent with the goal of stabilizing greenhouse gas concentrations in the atmosphere; (2) be sufficiently flexible to allow for new findings; (3) support continued economic growth and prosperity; (4) provide market-based incentives; (5) incorporate technological advances; and (6) promote global participation.

The President's decision to take a deeper look at climate change policy arose from the recognition that the international dialogue begun to date lacked the requisite participatory breadth for a global response to climate change. At the 1992 Earth Summit in Rio de Janeiro, the United Nations Framework Convention on Climate Change (UNFCCC) was adopted, with the ultimate objective of providing a higher quality of life

for future generations. Signatories pledged to:

> *achieve…stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a timeframe sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner.*

In Rio, ambitious plans were set in motion to address climate change. However, participation in constructing measures for adapting to and mitigating the effects of climate change fell short of the breadth necessary to confront a problem that President Bush recently said has "the potential to impact every corner of the world." A global problem demands a truly participatory global response, while at the same time taking near-term action that would reduce projected growth in emissions cost-effectively and enhance our ability to cope with climate change impacts.

Based on his Cabinet's review and recommendation, President Bush recently announced a commitment to reduce greenhouse gas intensity in the United States by 18 percent over the next decade through a combination of voluntary, incentive-based, and existing mandatory measures. This represents a 4.5 percent reduction from forecast emissions in 2012, a serious, sensible, and science-based response to this global problem—despite the remaining uncertainties concerning the precise magnitude, timing, and regional patterns of climate change. The President's commitment also emphasized the need for partners in this endeavor. All countries must actively work together to achieve the long-term goal of stabilizing greenhouse gas concentrations at a level that will prevent dangerous interference with the climate system.

For our part, the United States intends to continue to be a constructive and active Party to the Framework Convention. We are leading global research efforts to enhance the understanding of the science of climate change, as called for under the Framework Convention. We lead the world in investment in climate science and in recent years have spent $1.7 billion on federal research annually. Since 1990, the United States has provided over $18 billion for climate system research—more resources than any other country. In June 2001, President Bush announced a new Climate Change Research Initiative to focus on key remaining gaps in our understanding of anthropogenic climate change and its potential impacts.

As envisioned by the Framework Convention, we are helping to develop technologies to address climate change. The President has pledged to reprioritize research budgets under the National Climate Change Technology Initiative so that funds will be available to develop advanced energy and sequestration technologies. Energy policies improve efficiency and substitute cleaner fuels, while sequestration technologies will promote economic and environmentally sound methods for the capture and storage of greenhouse gases.

We plan to increase bilateral support for climate observation systems and to finance even more demonstration projects of advanced energy technologies in developing countries. President Bush's Western Hemisphere Initiative—created to enhance climate change cooperation with developing countries in the Americas and elsewhere—will also strengthen implementation of our Framework Convention commitments. In line with those commitments, we have provided over $1 billion in climate change-related assistance to developing countries over the last five years. All of this is just the beginning: we intend to strengthen our cooperation on climate science and advanced technologies around the world whenever and wherever possible.

We continue to make progress in limiting U.S. emissions of greenhouse gases by becoming more energy efficient. In the last decade, we have seen tremendous U.S. economic growth, and our level of emissions per unit of economic output has declined significantly. The President has committed the United States to continue this improvement and reduce intensity beyond forecast levels through enhanced voluntary measures. The United States is a world leader in addressing and adapting to a variety of national and global scientific problems that could be exacerbated by climate change, including malaria, hunger, malnourishment, property losses due to extreme weather events, and habitat loss and other threats to biological diversity.

Climate change is a long-term problem, decades in the making, that cannot be solved overnight. A real solution must be durable, science-based, and economically sustainable. In particular, we seek an environmentally sound approach that will not harm the U.S. economy, which remains a critically important engine of global prosperity. We believe that economic development is key to protecting the global environment. In the real world, no one will forego meeting basic family needs to protect the global commons. Environmental protection is neither achievable nor sustainable without opportunities for continued development and greater prosperity. Our objective is to ensure a long-term solution that is environmentally effective, economically efficient and sustainable, and appropriate in terms of addressing the urgent problems of today while enhancing our ability to deal with future problems. Protecting the global environment is too important a responsibility for anything less.

In this *U.S. Climate Action Report*, we provide our third formal national communication under the Framework Convention, as envisioned under Articles 4 and 12 of the Convention. We describe our national circumstances, identify existing and planned policies and measures, indicate future trends in greenhouse gas emissions, outline expected impacts and adaptation measures, and provide information on financial resources, technology transfer, research, and systematic observations.[1]

[1] Some sections of this report (e.g., the projections in Chapter 5) are included, despite the absence of a binding requirement to do so under the Convention. Note that these projections do not include the impact of the President's climate change initiative announced in February 2002, nor do they include the effects of measures in the *National Energy Policy* that have not yet been implemented.

The Science

Greenhouse gases are accumulating in Earth's atmosphere as a result of human activities, causing global mean surface air temperature and subsurface ocean temperature to rise. While the changes observed over the last several decades are likely due mostly to human activities, we cannot rule out that some significant part is also a reflection of natural variability.

Reducing the wide range of uncertainty inherent in current model predictions will require major advances in understanding and modeling of the factors that determine atmospheric concentrations of greenhouse gases and aerosols, and the feedback processes that determine the sensitivity of the climate system. Specifically, this will involve reducing uncertainty regarding:

- the future use of fossil fuels and future emissions of methane,
- the fraction of the future fossil fuel carbon that will remain in the atmosphere and provide radiative forcing versus exchange with the oceans or net exchange with the land biosphere,
- the feedbacks in the climate system that determine both the magnitude of the change and the rate of energy uptake by the oceans,
- the impacts of climate change on regional and local levels,
- the nature and causes of the natural variability of climate and its interactions with forced changes, and
- the direct and indirect effects of the changing distributions of aerosols.

Knowledge of the climate system and of projections about the future climate is derived from fundamental physics, chemistry, and observations. Data are then incorporated in global circulation models. However, model projections are limited by the paucity of data available to evaluate the ability of coupled models to simulate important aspects of climate. To overcome these limitations, it is essential to ensure the existence of a long-term observing system and to make more comprehensive regional measurements of greenhouse gases.

Evidence is also emerging that black carbon aerosols (soot), which are formed by incomplete combustion, may be a significant contributor to global warming, although their relative importance is difficult to quantify at this point. These aerosols have significant negative health impacts, particularly in developing countries.

While current analyses are unable to predict with confidence the timing, magnitude, or regional distribution of climate change, the best scientific information indicates that if greenhouse gas concentrations continue to increase, changes are likely to occur. The U.S. National Research Council has cautioned, however, that "because there is considerable uncertainty in current understanding of how the climate system varies naturally and reacts to emissions of greenhouse gases and aerosols, current estimates of the magnitude of future warmings should be regarded as tentative and subject to future adjustments (either upward or downward)." Moreover, there is perhaps even greater uncertainty regarding the social, environmental, and economic consequences of changes in climate.

Source: NRC 2001a.

The remainder of this chapter provides a brief description of the climate system science that sets the context for U.S. action, as well as an overview of the U.S. program that is the focus of this report.

NATIONAL CIRCUMSTANCES: THE U.S. CONTEXT

The perspective of the United States on climate change is informed by our economic prosperity, the rich diversity of our climate conditions and natural resources, and the demographic trends of over 280 million residents. Because of our diverse climatic zones, climate change will not affect the country uniformly. This diversity will also enhance our economy's resilience to future climate change.

Higher anthropogenic greenhouse gas emissions are a consequence of robust economic growth: higher incomes traditionally promote increased expenditures of energy. During the 1990s, investments in technology led to increases in energy efficiency, which partly offset the increases in greenhouse gas emissions that would normally attend strong economic growth. In addition, much of the economic growth in the United States has occurred in less energy-intensive sectors (e.g., computer technologies). Consequently, in the 1990s the direct and proportionate correlation between economic growth and greenhouse gas emissions was altered.

While the United States is the world's largest consumer of energy, it is also the world's largest producer of energy, with vast reserves of coal, natural gas, and crude oil. Nevertheless, our energy use per unit of output—i.e., the energy intensity of our economy—compares relatively well with the rest of the world. The President's new *National Energy Policy* (NEP) includes recommendations that would reduce greenhouse gas emissions by expanded use of both existing and developing technologies (NEPD Group 2001). The NEP's recommendations address expanded nuclear power generation; improved energy efficiency for vehicles, buildings, appliances, and industry; development of hydrogen fuels and renewable technologies; increased access to federal lands and expedited licensing practices; and expanded use of cleaner fuels, including initiatives for coal and natural gas. Tax incentives recommended in the NEP and the President's FY 2003 Budget will promote use of renewable energy forms and combined heat-and-power systems and will encourage technology development.

The nation's response to climate change—our vulnerability and our

ability to adapt—is also influenced by U.S. governmental, economic, and social structures, as well as by the concerns of U.S. citizens. The political and institutional systems participating in the development and protection of environmental and natural resources in the United States are as diverse as the resources themselves.

President Bush said last year that technology offers great promise to significantly and cost-effectively reduce emissions in the long term. Our national circumstances—our prosperity and our diversity—may shape our response to climate change, but our commitment to invest in innovative technologies and research will ensure the success of our response.

GREENHOUSE GAS INVENTORY

This report presents U.S. anthropogenic greenhouse gas emission trends from 1990 through 1999 and fulfills the U.S. commitment for 2001 for an annual inventory report to the UNFCCC. To ensure that the U.S. emissions inventory is comparable to those of other UNFCCC signatory countries, the emission estimates were calculated using methodologies consistent with those recommended in the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC/UNEP/OECD/IEA 1997).

Naturally occurring greenhouse gases—that is, gases that trap heat—include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and ozone (O_3). Several classes of halogenated substances that contain fluorine, chlorine, or bromine are also greenhouse gases, but for the most part, they are solely a product of industrial activities. Chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), and bromofluorocarbons (halons) are stratospheric ozone-depleting substances covered under the *Montreal Protocol on Substances That Deplete the Ozone Layer* and, hence, are not included in national greenhouse gas inventories. Some other halogenated substances—hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)—do not deplete stratospheric ozone but are potent greenhouse gases and are accounted for in national greenhouse gas inventories.

Although CO_2, CH_4, and N_2O occur naturally in the atmosphere, their atmospheric concentrations have been affected by human activities. Since pre-industrial time (i.e., since about 1750), concentrations of these greenhouse gases have increased by 31, 151, and 17 percent, respectively (IPCC 2001d). This increase has altered the chemical composition of the Earth's atmosphere and has likely affected the global climate system.

In 1999, total U.S. greenhouse gas emissions were about 12 percent above emissions in 1990. A somewhat lower (0.9 percent) than average (1.2 percent) annual increase in emissions, especially given the robust economic growth during this period, was primarily attributable to the following factors: warmer than average summer and winter conditions, increased output from nuclear power plants, reduced CH_4 emissions from coal mines, and reduced HFC-23 by-product emissions from the chemical manufacture of HCFC-22.

As the largest source of U.S. greenhouse gas emissions, CO_2 accounted for 82 percent of total U.S. greenhouse gas emissions in 1999. Carbon dioxide from fossil fuel combustion was the dominant contributor. Emissions from this source category grew by 13 percent between 1990 and 1999.

Methane accounted for 9 percent of total U.S. greenhouse gas emissions in 1999. Landfills, livestock operations, and natural gas systems were the source of 75 percent of total CH_4 emissions. Nitrous oxide accounted for 6 percent of total U.S. greenhouse gas emissions in 1999, and agricultural soil management represented 69 percent of total N_2O emissions. The main anthropogenic activities producing N_2O in the United States were agricultural soil management, fuel combustion in motor vehicles, and adipic and nitric acid production processes. HFCs, PFCs, and SF_6 accounted for 2 percent of total U.S. greenhouse gas emissions in 1999, and substitutes for ozone-depleting substances comprised 42 percent of all HFC, PFC, and SF_6 emissions.

Evidence is also emerging that black carbon aerosols (soot), which are formed by incomplete combustion, may be a significant anthropogenic agent. Although the U.S. greenhouse gas inventory does not cover emissions of these particles, we anticipate that U.S. research will focus more on them in coming years.

POLICIES AND MEASURES

U.S. climate change programs reduced the growth of greenhouse gas emissions by an estimated 240 teragrams (million metric tons) of CO_2 equivalent in 2000 alone. This reduction helped to significantly lower (17 percent since 1990) greenhouse gases emitted per unit of gross domestic product (GDP), and thus ranks as a step forward in addressing climate change.

However, the U.S. effort was given a potentially greater boost in June 2001, when President Bush announced major new initiatives to advance climate change science and technology. These initiatives came about after government consultation with industry leaders, the scientific community, and environmental advocacy groups indicated that more could and should be done to address scientific uncertainties and encourage technological innovation.

In February 2002, the President announced a new U.S. approach to the challenge of global climate change. This approach contains policies that will harness the power of markets and technology to reduce greenhouse gas emissions. It will also create new partnerships with the developing world to reduce the greenhouse gas intensity of both the U.S. economy and economies worldwide through policies that support the economic growth that makes technological progress possible.

The U.S. plan will reduce the greenhouse gas intensity of the U.S. economy by 18 percent in ten years. This reduction exceeds the 14 percent projected reduction in greenhouse gas intensity in the absence of the additional proposed policies and measures.

The new measures include an enhanced emission reduction registry; creation of transferable credits for emission reduction; tax incentives for investment in low-emission energy equipment; support for research for energy efficiency and sequestration technology; emission reduction agreements with specific industrial sectors, with particular attention to reducing transportation emissions; international outreach, in tandem with funding, to promote climate research globally; carbon sequestration on farms and forests; and, most important, review of progress in 2012 to determine if additional steps may be needed—as the science justifies—to achieve further reductions in our national greenhouse gas emission intensity.

The above strategies are expected to achieve emission reductions comparable to the average reductions prescribed by the Kyoto agreement, but without the threats to economic growth that rigid national emission limits would bring. The registry structure for voluntary participation of U.S. industry in reducing emissions will seek compatibility with emerging domestic and international approaches and practices, and will include provisions to ensure that early responders are not penalized in future climate actions. Furthermore, the President's approach provides a model for developing nations, setting targets that reduce greenhouse gas emissions without compromising economic growth.

PROJECTED GREENHOUSE GAS EMISSIONS

Forecasts of economic growth, energy prices, program funding, and regulatory developments were integrated to project greenhouse gas emissions levels in 2005, 2010, 2015, and 2020. When sequestration is accounted for, total U.S. greenhouse gas emissions are projected to increase by 43 percent between 2000 and 2020. This increased growth in absolute emissions will be accompanied by a decline in emissions per unit of GDP. Note that these forecasts exclude the impact of the President's climate change initiative announced in February 2002.

Despite best efforts, the uncertainties associated with the projected levels of greenhouse gas emissions are primarily associated with forecast methodology, meteorological variations, and rates of economic growth and technological development. In addition, since the model used to generate these projections does not completely incorporate all current and future policies and measures to address greenhouse gas emissions, these measures, as well as legislative or regulatory actions not yet in force, add another layer of uncertainty to these projections.

IMPACTS AND ADAPTATION

One of the weakest links in our knowledge is the connection between global and regional projections of climate change. The National Research Council's response to the President's request for a review of climate change policy specifically noted that fundamental scientific questions remain regarding the specifics of regional and local projections (NRC 2001a). Predicting the potential impacts of climate change is compounded by a lack of understanding of the sensitivity of many environmental systems and resources—both managed and unmanaged—to climate change.

Chapter 6 provides an overview of potential negative and positive impacts and possible response options, based primarily on *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change* (NAST 2000). This assessment used historical records, model simulations, and sensitivity analyses to explore our potential vulnerability to climate change and highlighted gaps in our knowledge.

The United States is engaged in many efforts that will help our nation and the rest of the world—particularly the developing world—reduce vulnerability and adapt to climate change. By and large these efforts address public health and environmental problems that are of urgent concern today and that may be exacerbated by climate change. Examples include reducing the spread of malaria, increasing agricultural and forest productivity, reducing the damages from extreme weather events, and improving methods to forecast their timings and locations. Besides benefiting society in the short term, these efforts will enhance our ability to adapt to climate change in the longer term.

Challenges associated with climate change will most likely increase during the 21st century. Although changes in the environment will surely occur, our nation's economy should continue to provide the means for successful adaptation to climate changes.

FINANCIAL RESOURCES AND TRANSFER OF TECHNOLOGY

To address climate change effectively, developed and developing countries must meet environmental challenges together. The United States is committed to helping developing countries and countries with economies in transition meet these challenges in ways that promote economic well-being and protect natural resources. This commitment has involved many players, ranging from government to the private sector, who have contributed significant resources to developing countries. As recognized in the UNFCCC guidelines, this assistance can take the form of hard and/or soft technology transfer.

Projects targeting hard technology transfer, such as equipment to control emissions and increase energy efficiency, can be particularly effective in reducing emissions. And projects that target the transfer of soft technologies, such as capacity building and institution strengthening through the sharing of technical expertise, can help countries reduce their vulnerability to the impacts of climate change. But whether hard or soft, technology transfer programs are most effective when they are approached collaboratively and are congruent with the development objectives and established legal framework of the target country. To this end, the United States works closely with

beneficiary countries to ensure a good fit between the resources it provides and the country's needs.

RESEARCH AND SYSTEMATIC OBSERVATION

The United States leads the world in research on climate and other global environmental changes, funding approximately half of the world's climate change research expenditures. We intend to continue funding research in order to ensure vigorous, ongoing programs aimed at narrowing the uncertainties in our knowledge of climate change. These research programs will help advance the understanding of climate change.

The President's major new initiatives directed at addressing climate change are informed by a wealth of input and are intended to result in significant improvements in climate modeling, observation, and research efforts. The long-term vision embraced by the new initiatives is to help government, the private sector, and communities make informed management decisions regarding climate change in light of persistent uncertainties.

EDUCATION, TRAINING, AND OUTREACH

The United States undertakes and supports a broad range of activities aimed at enhancing public understanding and awareness of climate change. These activities range from educational initiatives sponsored by federal agencies to cooperation with independent research and academic organizations. Nongovernmental organizations, industry, and the press also play active roles in increasing public awareness and interest in climate change.

The goal of all of these endeavors—education, training, and public awareness—is to create an informed populace. The United States is committed to providing citizens with access to the information necessary to critically evaluate the consequences of policy options to address climate change in a cost-effective manner that is sustainable and effective in achieving the Framework Convention's long-term goal.